A New Security of Supply Mechanism for the Iberian Market

So far, the Spanish electricity system is the only one in Europe to implement a security or reliability of supply mechanism from the outset. After 10 years of controversial operation, on the occasion of the regulatory harmonization required in the context of the Iberian electricity market, the Spanish regulator has finally decided to reform the system’s so-called “capacity guarantee mechanism.”

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I. Introduction

The design for a new regulatory framework for the Spanish electricity system – at the time one of the most advanced in the world – was polished off with reasonable success in a matter of a few months back in 1997. This initial scheme worked suitably in the early years, establishing the foundations on which the system would develop, with significant increases in efficiency on the one hand and the appearance of new actors on the other.

Although it was not explicitly stated in the law, the documents that reflected the previous discussions and agreements between the regulator and the industry foresaw that the new framework would need to be significantly revised five years later. Unfortunately, this revision did not take place. After this initial drive, in which the de-regulation of generation activity was the center of the
debate, the regulatory developments were mainly focused on other issues, namely on the regulated activities (transmission and distribution) as well as, for instance, the Special Regime scheme. On the wholesale and retail sides, the regulatory developments were confined to the introduction of a series of small patches whose outcome has been the present regulatory gridlock in the Spanish electricity market.

Although tardily and at a much slower pace than the situation required, reform of the original model has finally been undertaken. This process began with a White Paper commissioned by the Ministry of Industry, Tourism and Trade, followed by an (overly) long discussion period, in turn disrupted by large-scale capital operations – primarily the takeover bid for Endesa – and now appears to finally be translating into major changes. These include the institution of auctions for the purchase of power intended for regulated consumers (to be known in the future as "power supply of last resort") and stipulations requiring Endesa and Iberdrola to hold auctions offering virtual power plant capacity.

One of the initial provisions, which was controversial from the outset and has remained unchanged to date, was the "capacity guarantee mechanism" in place since the market first saw the light in 1998. The proposal for reform formulated by the White Paper was followed more than a year later by a proposal put forward by the Council of Iberian Energy Market Authorities in response to the commission received from the Spanish and Portuguese governments at the Portuguese-Spanish summit held in November 2006. This process culminated in September 2007, when the Spanish government published a Ministerial Order establishing a new mechanism for capacity payments, which in fact has very little in common with the Regulation Council’s proposal.

This article discusses the highlights of the proposal put forward by the Iberian Market Regulation Council for a security of supply mechanism for the Iberian electricity system. This design was developed by the authors of this article as part of a partnering project between the Pontifical University of Comillas’ Institute for Research in Technology and the Spanish National Energy Commission (CNE, the Spanish initials for Comisión Nacional de Energía), within the framework of close cooperation between the two Iberian countries’ respective electricity market regulators, the CNE and the Portuguese Energy Services Regulatory Authority (ERSE, for Entidade Reguladora dos Serviços Energéticos).

Section II below describes the backbone around which the proposal was structured, the context in which it was developed, and the regulations in force in the two systems. Section III discusses the fundamentals that delimit the scope of the proposal, while Section IV deals with some of the major implementation details. Finally, we briefly outline the main characteristics of the new security-of-supply design the Spanish government sketched in the Ministerial Order previously mentioned.

II. Context

A. The three dimensions of reliability of supply

Reliability of supply of electric power can be broken down into three consecutive and interrelated but distinguishable dimensions (Batlle et al., 2007). This distinction is instrumental to understanding the general context of the design formulated in this article.

- Short-term security is defined as the readiness of existing generating capacity to respond, when needed, to meet actual load (i.e., ancillary services).
- Firmness is defined as short-term generation availability resulting from the operational
scheduling of installed capacity (i.e., generator maintenance management, fuel supply contracts, reservoir management, and so on).

- Adequacy is understood to be the existence of sufficient available installed capacity.

The regulatory design proposed below addresses the final two layers of reliability, inasmuch as the existing framework is fitted with the necessary tools to guarantee short term “security” of supply.

### B. The capacity guarantee mechanism presently in place in Spain

The procedure used in Spain to secure firm capacity is extremely simplified and lacking in effective incentives for generators to be (or penalties for not being) available when needed. This is because the capacity on which each generator’s capacity payment is based is found by multiplying the mean percentage availability by a value that – broadly speaking – for thermal generators represents installed capacity and for hydroelectric units a different value for each month calculated as the mean of installed capacity and the mean of the energy produced in this particular month in the previous five years.

Theoretically, it constitutes an incentive for availability and investment, but in practice the availability signal is very weak, for the only hours not paid are the ones when capacity is not available; i.e., payments for the rest of the year continue to be received.

While a substantial number of combined-cycle plants have come on-stream in the Spanish system since 2002, reasonable doubts may be raised about whether the present capacity guarantee mechanism has actually acted as a significant incentive for investment. The total volume of payments for this item declined from an initial $7.8 per MWh of system demand at market start-up in 1998 to $4.8/MWh in 2006.

The perception that it may be changed at regulator discretion has generated considerable regulatory uncertainty about reliability of supply payments. Consequently, the ability of this mechanism to effectively encourage long-term investment is at least questionable.

### C. The capacity guarantee mechanism presently in place in Portugal

The Portuguese system’s power purchase agreements or “contratos de aquisição de electricidade” (CAE) provide implicitly for availability-related remuneration that constitutes a short-term capacity guarantee. In addition, producers’ fixed remuneration under the CAEs depends on availability as verified by the system operator.

Ordinary system producers that are not parties to CAEs participate in the market without receiving any capacity guarantee payment.

Adopting a long-term perspective, the Portuguese legislation implementing the European Internal Energy Market Directive envisages the possibility of public auctions to assign new output capacity values in situations in which the market is unable to guarantee sufficient capacity in reserve.

The harmonized mechanism for the Iberian peninsula discussed below seeks to cover the other two dimensions of reliability of supply, namely firmness and adequacy, in an attempt on the one hand to establish an incentive for generators to increase their availability and on the other to institute an additional incentive for investment.

### III. General Outline of the Proposal

The present description of the main outline of the design proposed is preceded by a discussion of the fundamental criteria that should underlie any
regulatory system geared to guaranteeing the supply of electric power in a market environment.

A. General fundamental criteria

The design proposed intends to broach the problem of reliability of supply from the vantage of regulation by establishing a mechanism built on the three basic criteria listed below, by order of relevance:

1. Regulatory stability

The primary characteristic that a regulatory design must feature, above and beyond its own orthodox definition, is the insurance of the highest guarantee of stability. In this regard, reliability of supply is given priority if the regulator is able to convey to the market agents rigorous respect for the rules at all levels, and not only the rules explicitly designed for this purpose, to create an incentive for sufficient coverage. This vision is embodied in the design proposed from two standpoints:

- Looking forward, the mechanism is designed to send stable signals to potential investors, defining:
  - Incentive for availability (firmness): a methodology to assess generators’ contribution to reliability (a measure that generators themselves may manage in the future). Henceforth, remuneration for this item would be associated with availability (i.e., effective production) in periods of scarcity, which would be defined as periods when the price is abnormally high.
  - Incentive for investment (adequacy): A commitment whereby the regulator guarantees remuneration for new entrants for a set number of years (e.g., five to seven).
- Looking back, in the case of the Spanish system, in order to signal regulatory stability (and guarantee) from the very moment the new design is implemented, recently commissioned units already in the system would continue to receive the remuneration paid to date for that item through the end of the stipulated term, which should be the same as for future new entrants (five or seven years).

2. Development of market mechanisms

Starting from the design of the capacity guarantee in place to date in Spain, the proposal set out hereunder tends toward an approach in which it would either not be necessary to provide for explicit payment for this item or, if such remuneration did exist, it would be established in strict accordance with market mechanisms.

Along these lines, the intention is to minimize the number of parameters subject to system regulator and/or operator subjectivity until such time as the market (in particular, demand) reaches the maturity required to be able to dispense with a mechanism of this nature. Wherever possible, the design opts to establish signals and enable agents to incorporate them as a component of generating unit management. The mechanism established assesses generators’ contributions on the grounds of their output during periods in which prices are abnormally high so that agents can manage their own plants’ firm capacity.
3. Orthodoxy and regulatory transparency

The design seeks to guarantee supply in the Iberian system by means of a transparent, objective and coherent methodology, from two complementary vantages: it aims to establish both a genuine incentive for generators to maximize their availability when most needed, and an investment signal whose effectiveness is based on design clarity and stability.

B. General framework

The design combines two complementary elements of regulation:
- A reliability supplement, allocated administratively at the outset and comprising two components: an availability incentive (firmness) for all system generators and an investment incentive (adequacy).
- A procedure to ensure a preset margin of available installed capacity in reserve in respect over and above demand, in the event it is not provided by the market of its own accord or the above-mentioned administrative incentive for investment.

1. Administrative allocation of a reliability product

This section describes, firstly, the methodology proposed for evaluating each generator’s contribution to reliability, and secondly, the two components of reliability: the availability incentive and the investment incentive.

a. Methodology to evaluate contribution to reliability

The first step is to define a reliability product, such as effective production in periods of scarcity, and a methodology to evaluate generators’ contribution to Iberian system reliability, based on two new parameters: scarcity price and firm capacity, defining for this purpose:
- A scarcity price or price level indicating that the system may be close to incurring a supply shortage.
- The initial firm capacity for each generator in the system that measures its effective contribution to capacity.
- A rule for updating generator firm capacity based on actual availability during the hours when the market price is higher than the scarcity price.

Subsequently, a generator’s firm capacity value would be updated in accordance with its actual output in the hours when the reference market price (daily and successive markets, down through the real time market, as discussed below) is higher than the scarcity price. Given that generators’ updated firm capacity value would have an impact on their future allocations (non-compliance in one year would lower their firm capacity value and with it their right to remuneration in future years, when the availability incentive may be higher), it would act as an additional incentive to increase set availability.

With the measure thus defined, the reliability of supply allocation can be broken down into two items.

b. Incentive for availability

A certain sum would be earmarked to encourage generators to increase their availability. This sum, defined as a yearly payment (subject to commitments and the respective penalties described below), would be allotted on the basis of the firm capacity defined for each.

In return for such sums, generators would acquire the commitment to provide the firm capacity allocated when the reference market price is higher than the scarcity price.

The consequences for generators of breach of this commitment would be:
- Return of part of the reliability of supply payment received.
- Reduction of their firm capacity in future years.

To this end, the regulator must define two formulas, one to establish the sum to be returned on the grounds of the megawatts of firm capacity not provided in
each hour when the market price was higher than the scarcity price, and the other to calculate the decline in future firm capacity.

c. Incentive for investment

As an additional incentive, the reliability of supply payment would be supplemented with another remuneration that aims to intensify investment in the Iberian system. This additional component would be guaranteed to generators during the first few years of operation (five to seven).

The amount of this remuneration – although not the methodology, which would be the same in the Portuguese and Spanish systems – might transitionally (while the cross-border constraint is in effect) not be based on the same value per megawatt of installed firm capacity in the two systems. During this transitional period, the investment incentive might be freely used by each regulator as a tool to harmonize the margin in reserve in the two systems.

As noted above, in the Spanish system the stability signal stemming from the investment incentive for the first few (five or perhaps seven) years of operation of units already installed in the system would be maintained for the time remaining until that period lapses. The generators with time remaining would continue to receive the payment in place to date: i.e., they would receive the capacity payment through the end of the five (or seven) years, although they would be subject to the same new conditions as all other actors and have to be available whenever the market price is higher than the scarcity price.

The capacity payment (corresponding to the availability incentive and the investment incentive) must constitute a fixed sum per firm megawatt (€/MW year) and therefore must not depend on power demand, as has been the case in Spain to date.

2. Auction for the value of the investment premium for new entrants

The new element consists in defining a procedure that would enable regulators to ensure a pre-set margin of available installed capacity in reserve over and above demand, in the event it is not provided by the market of its own accord or the above-mentioned administrative incentive for investment. The auction should only be held in the absence of sufficient generating capacity to provide the desired margin.

The idea proposed consists in allowing the respective regulators to call an auction when they detect underinvestment in the system, so that new entrants can determine the value of the investment incentive that they need to enter the market, while for incumbents, by contrast, the incentive would be a regulated and pre-set value.

There is an obvious drawback to this alternative: the optimal capacity in reserve should ideally be defined by market forces themselves. Consequently, it should be viewed as a tool that is justified solely as a support measure in the transitional period ending as soon as demand reaches the necessary maturity for the regulator to be able to refrain from intervening along these lines.

The regulator, then, in conjunction with the system operator, would be entrusted with supervising the amount of power generation foreseen for some time horizon (from two to four years), taking into consideration existing units along with facilities to be commissioned and de-commissioned in the interim.

If that amount of power generation is found to be lower than the target figure for firm installed capacity, an auction would be called for the difference between the two values. Both new units installed in the system that have yet to win an auction as well as new entrants would be eligible to take part. The winners would be paid the auction price for the term remaining to the date set as
the end of the guaranteed investment incentive period. The aim is to prevent the postponement of new investment entry until auctions are called.

The result of the auction would consist in allotting to the winning generators reliability of supply obligations analogous to the obligations in place for incumbents, which would begin after a given period of time (from two to four years) and remain in effect for as long as the investment incentive is received. Incumbent generators would acquire the obligation until the said term lapses, counting from when they entered the system. In exchange, these units would also receive the marginal price resulting from the auction during the time that their obligation is in force.

Once the guarantee period lapses (or, for existing generators, this period less the time since they were commissioned), these generators, like all the incumbent units, would only receive the availability incentive.

3. General allocation of payments for the Iberian system
   a. Allocation of the incentive for availability

The incentive for availability constitutes remuneration whereby regulators, on behalf of Iberian system demand, seek to establish an incentive in addition to the encouragement implicit in the short-term signal conveyed by the market price of power.

Under the present proposal, payment allocation for this item would be established in accordance with the following criteria:
   - On the demand side, the proposal envisages payment of the same amount per unit of power consumed for all Iberian market consumers, regardless of their location. The intention is for the signal conveyed through this payment to be uniform regardless of geography, paving the way for tariff harmonization.
   - On the generation side, as noted, each system regulator would be transitionally in charge of determining the amount to be paid for this item per megawatt of firm capacity.
   - On the demand side, since this amount is linked to an individual decision on the part of each area’s regulator, payment would be allotted among each system’s consumers accordingly.

IV. Implementation Details
   A. The scarcity price

The scarcity price is the threshold that enables the regulator to transparently define the hours during which system generators’ availability will henceforth be evaluated.

In the case of the Iberian market, where the market price is obtained from the bid price (i.e., the marginal system price corresponding to the marginal system operating cost11), the scarcity price must correspond to the cost of operating reasonably efficient advanced technology with high operating costs. This rules out the possibility of regarding the scarcity price as a call option.
strike price. In other words, generators do not have to return the difference between the market price and the established threshold if they are not producing electricity, as proposed in the original reliability options scheme described by Vázquez et al.\textsuperscript{12} or in the Spanish White Paper proposal. Generators’ penalty consists of having to reimburse part of the capacity payment and accept recalculation of their units’ firm capacity, on which future remuneration will be based.

Consequently, operating arrangements must be defined to calculate the aforementioned costs, which may be significantly impacted by startups and other technical operating conditions. Here the proposal calls for calculating the threshold price based on the operating costs of a reasonably efficient natural-gas-fired turbine having to generate power for a certain number of consecutive hours. A fuel-oil-fired unit might be considered as an alternative, but in the medium term these facilities will most certainly cease to be optimal, cutting-edge technology.

The scarcity price would be revised gradually upward and clear indexing rules would be established to enable agents to know the formulas governing their future evolution. Such indexing would refer primarily to international fuel prices and the price of CO\textsubscript{2}, in an attempt to reproduce the impact of these two variables on the operating costs of the latest technology taken as a reference.

1. Reference market and allocation of responsibilities

The reference price would be the daily market and subsequently the secondary markets (intraday and regulation) down through real time. The terms of the proposal are:

- All generators receiving reliability of supply payments would be required to submit a program to the system operator in which they commit to producing at least their firm capacity in the hourly intervals when prices exceed the established threshold or be penalized with reimbursement of part of such payments.
- They may meet this obligation either by means of bids submitted to the OMEL\textsuperscript{13} daily market or via OTC agreements.
- Generators whose production is not needed on the daily market because the market price has not crossed the price threshold would not be required to produce. This means not having to demand very short reaction times of certain units with slow startups.

Rules would also be needed to prevent certain types of illicit behavior. For instance, generators having security-of-supply commitments that are unable to produce power should not be able to sell power on the daily market, but only to repurchase it via bids on subsequent markets – the intraday market, for instance – in an attempt to avoid the penalty.

B. Determining firm capacity value

1. Allocating initial firm capacity values

The first step consists in estimating the output that a generator can guarantee during high-price hours. In order to introduce the measure gradually and avoid initial uncertainty and instability, the first firm capacity value would be calculated and allocated to each generator administratively. The methodology should advisably start from an initial value which would then be adjusted in light of system developments and each generator’s actual contribution to firm capacity.

2. Safeguards

In addition, this type of general criteria should be attuned to the specific conditions prevailing at each facility, so that certain safeguards are built into firm capacity calculations: one example might be a provision to cancel the firm capacity
commitments of a generator unable to produce power due to environmental restrictions.

a. Minimum firm capacity values
A minimum firm capacity level would be established for each generator – a percentage of the initial value, such as 70 percent – below which it may not be reduced, to prevent an excessive lowering of these amounts that might place the system in a vulnerable situation from the standpoint of supply reliability.

The firm capacity determined administratively for each unit would be a maximum figure. Agents realizing they are unable to comply with the obligation imposed may modify this amount downward, but under no circumstances would it be revised upward.¹⁴

b. Grid constraints
The transmission grid may limit generating units’ effective contribution to system continuity of supply. One clear example would be a small area on the system with insufficient capacity to accommodate the amount of generating power installed on it.

The output guaranteed to the system by generating units located in areas with limited grid capacity must never exceed that capacity. The proposal is therefore to:

- Limit the firm capacity acknowledged to all the generators on a node to the maximum output that can be simultaneously accommodated.
- Allocate the aggregate firm capacity among units on a pro rata basis of the firm capacity that would have been allocated to each in the absence of grid constraints.

C. Penalization procedures
The two consequences for generators in breach of the commitment associated with receipt of the availability or investment incentive are:

- Reduction of their firm capacity in future years.
- Return of part of the reliability of supply payment received.

To this end, the regulator must define two formulas, one to establish the sum to be returned on the grounds of the megawatts of firm capacity not provided in each hour when the market price was higher than the scarcity price, and the other to calculate the decline in future firm capacity.

1. Updating the firm capacity value
A rule must be defined for updating generators’ firm capacity depending on their actual availability during the hours when the market price is higher than the scarcity price. The firm capacity value would be updated depending on generators’ output during the hours when the reference market price exceeds the scarcity price.

Even that generators’ updated firm capacity value would have an impact on their future allocations (non-compliance in one year would lower their firm capacity value and with it their right to remuneration in future years, when the availability incentive may be higher), it would act as an additional incentive to increase unit availability.

Broadly, the procedure is as follows: the general criterion established is that a generator’s firm capacity is its mean output over the last five years during the hours when the market price was higher than the scarcity price. Five-year intervals are established to take account of rainfall cycles and potential periods of fossil fuel supply shortages. Otherwise, the door would be open to changing supply reliability commitments depending on a year’s rainfall forecast or gas prices, disregarding the long-term planning criteria that should govern such allocations.

2. Refund formula
Supply reliability payments would translate into a fixed yearly remuneration per megawatt of installed firm capacity (€/MW year), which would be higher for generators having participated in

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the system for a time shorter than the term associated with the investment incentive (five or seven years).

If a generator fails to produce the amount stipulated, the conclusion drawn is that its firm capacity in place to date was incorrect and therefore, not only should it be modified in future, but, as described in the preceding item, the generator must also refund the amount corresponding to the reduction in its firm capacity imposed as a result of its non-compliance.

The refund rule states that: if a generator’s firm capacity is lowered by a given percentage for non-compliance, it must return the same percentage of the supply reliability (availability incentive and investment incentive as appropriate) revenues received over several (two, for instance) years prior.

V. The New “Capacity Service”

Soon after the publication of the Council’s proposal, the Spanish Government issued a Royal Decree15 in which it stated that a new capacity payment mechanism would be in force by Oct. 1 that mainly would consist of “two types of incentives, one aimed to promote generation investments and another one devoted to stimulate the availability of the power system installations.” Therefore, it seemed as though the purpose of the Spanish Government was to follow the Council’s proposal.

However, days before this paper was submitted, in its response to the Government Ministerial Order,16 the Spanish National Energy Commission stated that the mechanism that finally is going to be put in place in (at least for the moment just) the Spanish electricity system “in certain relevant aspects . . . is not in line with the proposal put forward by the Council of Iberian Energy Market Authorities.”17

The aforementioned Order ITC/2794/2007 establishes that the former “capacity guarantee mechanism” is replaced by “capacity payments.” This concept involves two clearly differentiated services:

- The availability service, aimed at allowing the system operator to enter into bilateral contracts, lasting no longer than one year, with peaking units (as, for instance, fuel-fired plants and the hydro limited energy plants).18
- The investment service, a capacity payment expressed in euros per installed megawatt and year for those units larger than 50 MW during their first 10 years of operation. The installations benefiting from this payment will require an administrative authorization issued by the General Direction for Energy Policy and Mines.19

This investment incentive (II) depends on the value of a so-called “reserve margin index” (índice de cobertura in Spanish, or IC) that will be calculated by the system operator. While the value of this index is below 1.1, the II is set to 28,000 euros per installed megawatt and year. If the value of the index is above 1.1, the II will be calculated as

\[ II = \left( \frac{193,000}{150,000} \right) \cdot IC. \]

There are consequences for generators in breach of their commitment.
Additionally, along the lines of the previous proposals already described in this article, the Order establishes that the government might implement auction mechanisms to allocate the investment incentive where needed to meet energy policy and security of supply objectives or if the IC falls below 1.1.

Endnotes:


6. This means that if the term in which payment is guaranteed is five or seven years, for instance, a generator coming on-stream now would receive such payments until 2011 or 2013.

7. While not forming a part of the administrative mechanism for the payment received by generators for their contribution to system firmness and adequacy, it is regarded as essential in guaranteeing demand coverage.

8. Given that for the time being the likelihood of interconnection constraints is high, with the concomitant division into two different price zones, the issue of whether it may make sense to define different “scarcity prices” in Spain and Portugal needs to be addressed.

9. This term should not be overly long, for two reasons: on the one hand, regulators should attempt to minimize any limitation on either future electricity system development or the investment signal transmitted by market forces; and on the other, account should be taken of the fact that investors tend to undervalue potential revenues beyond a reasonable period of years, for their instantaneous risk rate grows with the length of the term, inasmuch as they discount the growing regulatory risk from future years’ revenues.


14. In any event, since the design of the mechanism does not initially envisage penalizing generating units for amounts in excess of the incentive received in the preceding years, it makes no sense for them to opt for this alternative.


17. Authors’ translation of “no se ajusta a la propuesta realizada por el Consejo de Reguladores en aspectos relevantes.”

18. The Order establishes that the service has to be designed in coordination with the Portuguese side, in the Iberian market context.

19. The payment is linked just to the installed capacity approved by the Ministry; there is no mention of any later availability requirement or “firm capacity” measure.